MAP
LGL-3-8
1491

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Intermountain Forest and Range Experiment Station
REED W. BAILEY, DIRECTOR
Ogden, Utah March 1, 1956

AN ANALYSIS OF DOUGLAS-FIR TUSSOCK MOTH COCOONS WINTER OF 1955-1956 WITH REFERENCE TO THE TREND OF THE CURRENT OUTBREAK IN EASTERN WASHINGTON

By Harold R. Dodge, Entomologist

Prepared By The
Forest Insect Laboratory
Missoula, Montana

AN ANALYSIS OF DOUGLAS-FIR TUSSOCK MOTH COCOONS WINTER OF 1955-1956 WITH REFERENCE TO THE TREND OF THE CURRENT OUTBREAK IN EASTERN WASHINGTON

In the summer of 1955 considerable defoliation by the Douglas-fir tussock moth, Hemerocampa pseudotsugata McD., occurred in eastern Washington, from the environs of Colville southeastward to Latah. Over 9,000 acres were aerially mapped as infested, and a ground check made by the Missoula Forest Insect Laboratory in October confirmed the findings of the aerial survey. During this check a striking feature was the scarcity of 1955, or "new" egg masses (1). This was reported at a meeting in Colville, November 29, 1955, of a subcommittee of the Northwest Forest Pest Action Committee, and it was agreed that the Forest Insect Laboratory, with the assistance of several cooperating agencies who offered to undertake the field work, would make a winter survey of cocoons before advising whether 1956 aerial spraying was necessary to protect timber values.

An instruction sheet on sampling techniques was prepared for the cooperators by the writer. Its use was explained at a meeting in Colville on December 14 as a preliminary step in inaugurating the survey. This meeting was attended by John Link, Washington State Division of Forestry; Roswell Leavitt, Floyd Cory and Oak Knapp, Colville National Forest; Elmer Kegel, County Farm Forester; Victor H. Barry, Soil Conservation Service, and others. Grateful acknowledgement is made to these men, whose cooperation in collecting samples made this report possible. Peter N. Dyson, graduate student in the School of Forestry, Montana State University, Missoula, assisted in the examination of the cocoons.

Methods

The cooperators were instructed to pick all cocoons as they found them, and samples were sometimes obtained by felling or climbing trees when an adequate sample could not be obtained by hand picking from the ground, or by pole pruners. The cocoons were bagged and taken to the Washington State Division of Forestry office at Colville. Here, the collecting points were spotted on a map.

At Missoula the cocoons were individually opened and examined under a low-power microscope and the emergence or cause of death of each insect was usually easily determined. A form was devised for recording the results for each collection.

Results

The results of the cocoon examination are tabulated in table 1, in which the collections are divided into three geographic subsections, namely (1) Colville and vicinity, which comprises all of the forest infestation, (2) Deer Park, where farmsteads adjacent to forests are found infested, and (3) Spangle-Latah, where the firs are found only about farmsteads and villages, far removed from natural stands.

Table 1.--Summary of Douglas-fir tussock moth egg masses and cocoons collected in northeastern Washington winter of 1955-1956

General collecting areas		Number of collection sites	Moth egg masses		Tussock moth cocoons			
			1955	Older	Successfully emerged	Killed by Parasites	Killed by Other	Total
Colville,	number	40	81	495	1,025	3,296	304	4,625
	percent		1.7	10.7	22.2	71.3	6.5	
Deer Park,	number	4	43	73	245	480	75	800
	percent		5.4	9.1	30.6	60.0	9.4	
Spangle-Latah,	number	8	83	116	428	292	100	820
	percent		10.1	14.1	52.2	35.6	12.2	
Totals,	number	52	207	684	1,698	4,068	479	6,245
	percent		3.3	11.0	27.2	65.1	7.7	

The above table is summarized from more complete data given in the appendix. From these data the following four points are elaborated:

A. Ratio of new to old egg masses.--This is probably the most significant result of the survey. A total of 6,245 cocoons yielded 207 new and 684 old egg masses (3.3 percent versus 11.0 percent). Since defoliation was greatest in 1955, it may be assumed that the majority of the old egg masses are of 1954 origin. When an epidemic is building up (site D-2, appendix) the new egg masses greatly outnumber the old. Many of the new egg masses came from a few collecting points (sites D-1, D-2, D-5, 37, 39, appendix) which are all farmstead infestations, not typical of the forested lands. Others (sites 31, 36), with a relatively high percentage of new egg masses, are collections too small to evaluate. From this, the present epidemic appears to be receding, particularly in the forested areas about Colville, where 6.3 old egg masses were found for each new one.

B. Ratio of egg masses to total cocoons.--Only 14.3 percent of the cocoons yielded egg masses of any age, so it is at once apparent that there has been a high mortality of the tussock moth during the short but critical cocoon stage. Ordinarily half of the cocoons would give rise to female moths, so 50 percent egg masses would be normal in an unparasitized population.

C. Parasitism.--Of all the cocoons examined, 65.1 percent were parasitized. Parasitism was highest in the Colville region, where it averaged 71.3 percent. Of this amount 66.8 percent is attributed to larvae of a sarcophagid fly, probably Pseudosarcophaga affinis (Fall.). Though the mature larvae of this parasite usually leave the host to pupate in the soil, the type of feeding is distinctive, and often small dead larvae remain within the host (presumably from overpopulation) to positively identify the parasite. The scarcity or absence of this fly in the farmstead infestations, particularly in the Spangle-Latah area, is marked, and is probably the reason why the farmsteads are more heavily defoliated and with a relatively high number of new egg masses.

Other parasites are a tachinid fly which pupates within the host caterpillar and emerges the same season, and several species of Hymenoptera, including Theronia fulvescens Cress. In the presence of the sarcophagid these other parasites are evidently killed, along with the host; in the absence of the sarcophagid they accounted for 28 percent of the cocoons (site D-7).

D. Survival of the eggs.--In mid-November 1955 this region was submitted to an unusually early and severe cold spell. The question immediately arises; "What effect will this have on the overwintering eggs?" While the eggs of some collections appeared unusually desiccated, larvae have been abundantly hatching at the Laboratory from other collections. It is therefore certain that survival does occur; also, probably, some of the eggs were subjected to unusual dryness in the Laboratory.

Discussion

Because the cocoons persist for a long time and the wingless female tussock moth is obliged to lay her eggs on her own cocoon, a cocoon examination is possible any time during the dormant season, and will give valuable information on the trend of the population through evidence of egg masses and parasites. However, the various parasites and other mortality factors which affect the moth larvae before the cocoon stage cannot be assayed unless an observer is in the field during the summer. Certainly "pre-cocoon" mortality may at times be an important factor, and it has been apparent several times while collecting the samples. Certain areas which are relatively heavily defoliated do not yield many cocoons, whereas the reverse of this condition is sometimes found. In one area "scorching" of the new foliage by young larvae was very conspicuous, in contrast to the paucity of cocoons and light "stripping" damage of the larger larvae.

One unfortunate aspect of the winter survey is the fact that the age of cocoons cannot be accurately determined, except those possessing new egg masses. The figure of parasitism is therefore not an accurate expression of the 1955 rate of parasitism, though it may approach it if it could be proved that the great majority of the cocoons are of 1955 origin.

Other parasites are a tachinid fly which pupates within the host caterpillar and emerges the same season, and several species of Hymenoptera, including Theronia fulvescens Cress. In the presence of the sarcophagid these other parasites are evidently killed, along with the host; in the absence of the sarcophagid they accounted for 28 percent of the cocoons (site D-7).

D. Survival of the eggs.--In mid-November 1955 this region was submitted to an unusually early and severe cold spell. The question immediately arises; "What effect will this have on the overwintering eggs?" While the eggs of some collections appeared unusually desiccated, larvae have been abundantly hatching at the Laboratory from other collections. It is therefore certain that survival does occur; also, probably, some of the eggs were subjected to unusual dryness in the Laboratory.

Discussion

Because the cocoons persist for a long time and the wingless female tussock moth is obliged to lay her eggs on her own cocoon, a cocoon examination is possible any time during the dormant season, and will give valuable information on the trend of the population through evidence of egg masses and parasites. However, the various parasites and other mortality factors which affect the moth larvae before the cocoon stage cannot be assayed unless an observer is in the field during the summer. Certainly "pre-cocoon" mortality may at times be an important factor, and it has been apparent several times while collecting the samples. Certain areas which are relatively heavily defoliated do not yield many cocoons, whereas the reverse of this condition is sometimes found. In one area "scorching" of the new foliage by young larvae was very conspicuous, in contrast to the paucity of cocoons and light "stripping" damage of the larger larvae.

One unfortunate aspect of the winter survey is the fact that the age of cocoons cannot be accurately determined, except those possessing new egg masses. The figure of parasitism is therefore not an accurate expression of the 1955 rate of parasitism, though it may approach it if it could be proved that the great majority of the cocoons are of 1955 origin.

The parasite population peak is obliged to lag behind that of the host, and that it does so is quite apparent in the evidence of collection number 11 vs. 14 (appendix). These collection sites are less than 2.5 miles apart in a region of general infestation, yet there is evidence of some calamity that wiped out the caterpillars at site 14 before they "spun up". Cocoons at 14 were scarce, and yielded no new egg masses, but 63 percent of them had produced moths and parasitism was only 20.7 percent. Cocoons from collection number 11 were numerous, yet only 9 percent had produced moths and 89.3 percent were parasitized. Both collection sites were defoliated in 1955, therefore the only conclusion is that a calamity befell the growing caterpillars at site 14 during the summer of 1955, hence there are no or few 1955 cocoons. If we could allow for old cocoons at site 11 we would probably find that 1955 parasitism approached 100 percent.

The severe defoliation in farmsteads in this region can be interpreted as merely a symptom of the epidemic in the adjacent woodlands, and not its cause. Defoliation in the forests is apparently less intense because of more constant decimation by natural enemies which are scarce or absent about the farmsteads.

Conclusion

Abatement of epidemics of the Douglas-fir tussock moth through natural enemies is not a new phenomenon, and has been reported often enough (2, 3 and 4) that it is probably the general rule that epidemics recede before serious damage has been done to the forests. The present epidemic appears to be subsiding in all forested areas examined, with possible exception of collection site 31, which site is not known to the writer, and may not be typical of the forest.

In the farmsteads the epidemics have not always abated, and it is possible that new infestations will appear in the summer of 1956. These infestations, serious as they may be, do not appear to be a matter of great concern to the owners of adjacent forest lands, since they have not spread to the forests.

References

(1) Gibson, A. L. Memorandum to files, Forest Insect Laboratory, Intermountain Forest and Range Experiment Station, Missoula, Montana. November 1955.

(2) DeLeon, D. 1931. Seasonal history and biology of the tussock moth in the Northport area for the season of 1930. Forest Insect Laboratory, Bureau of Entomology and Plant Quarantine, Coeur d'Alene, Idaho, 1931. 12 pp. 7 photos (unpublished).

(3) Johnson, P. C. 1949. Natural decline of tussock moth infestations in the Inland Empire. Forest Insect Laboratory, Bureau of Entomology and Plant Quarantine, Coeur d'Alene, Idaho, January 28, 1949. pp. 2 and 6 (unpublished).

(4) Orr, L. W. 1951. Present status of Douglas-fir tussock moth outbreak in Owyhee County, Idaho. Forest Insect Laboratory, Bureau of Entomology and Plant Quarantine, Ogden, Utah, September 24, 1951. 2 pp. (unpublished).

Appendix.--Summary, by collection sites, of Douglas-fir tussock moth egg masses and cocoons collected in northeastern Washington, winter of 1955-1956

Field collections					Moth egg masses percent		Tussock moth cocoons				
							Successfully emerged percent	Killed, by percent			Total number
								Parasites		Other	
Site no.	Locality	Sec.	Twp. (N)	Rge. (E)	1955	Older		Sarcophag.	Total		
	(1) COLVILLE & VICINITY										
2	Blue Creek	34	33	39	0.0	0.0	4.8	45.2	80.9	14.3	42
7	Colville	1	36	38	0.0	2.0	2.0	96.0	98.0	0.0	51
10	Colville Mitchell farm	20	35	39	0.0	16.2	23.5	64.4	68.7	7.8	191
11	Arden	16	34	39	0.3	2.3	9.0	86.7	89.3	1.7	300
12	Arden	17	34	39	6.6	2.6	14.5	82.9	84.2	1.3	76
13	Orin	32	35	39	0.0	31.6	36.8	52.6	52.6	10.6	19
14	Arden--Stene-hjen ranch	30	34	39	0.0	49.4	63.2	20.7	20.7	16.1	87
15	Orin	31	35	39	0.0	16.2	16.2	70.3	73.0	10.8	37
16		13	34	38	0.0	9.7	18.6	78.2	79.8	1.6	124
17		14	36	38	1.0	5.5	16.4	73.6	80.2	3.3	91
18	= #7	1	36	38	1.1	6.6	10.0	85.3	86.7	3.3	91
19		3	36	38	2.1	3.1	8.5	86.2	86.2	5.4	94
20	Allison ranch	25	37	38	0.0	2.8	5.1	93.2	93.8	1.1	177
21	Knapp Woodlot	18	36	39	1.6	4.0	12.7	82.5	83.3	4.0	126
22		35	33	39	4.5	5.9	18.9	78.0	79.7	1.4	222
23	Reese ranch	32	33	39	0.0	15.1	32.8	52.9	61.3	5.9	119
24		5	32	39	0.0	7.7	10.8	81.6	85.4	3.8	130

Appendix summary (continued)

Field collections					Moth egg masses percent		Tussock moth cocoons				
							Successfully emerged percent	Killed, by percent			Total number
								Parasites			
Site no.	Locality	Sec.	Twp. (N)	Rge. (E)	1955	Older		Sarcophag.	Total	Other	
25	A. V. Peters	31-2	36	39	0.0	15.5	28.2	64.5	68.1	3.7	245
26	Barton ranch	20	36	39	0.0	8.9	13.4	74.6	80.6	6.0	67
27	W.S.Chamberlain	20	35	40	5.0	3.0	30.8	58.1	65.7	3.5	198
28	Chas. Hodde	3	35	39	0.0	29.2	40.4	32.6	46.1	13.5	89
29	" "	3	35	39	3.5	5.6	35.5	59.3	60.4	4.1	197
30	Richmond ranch	23	36	39	0.0	5.9	10.6	76.5	85.9	3.5	85
31	Howard Matthews	22	36	39	27.3	9.1	54.5	27.3	27.3	18.2	11
32	Darringen ranch	2	36	39	8.5	8.5	29.8	61.7	61.7	8.5	47
33	Fred Alby	33	33	38	3.8	33.7	47.2	33.7	40.4	12.4	89
34		26	33	38	5.1	7.7	25.7	51.3	55.1	19.2	78
35		33	33	38	1.8	26.4	47.3	47.3	48.2	4.5	110
40	Reed's place	34	36	38	4.2	1.4	11.2	85.5	87.4	1.4	214
41		16	36	38	.0	30.5	36.7	55.5	60.2	3.1	128
42	Lowell Meyer	28	36	38	.0	42.5	42.5	40.4	53.2	4.3	47
43	Frank Lane	20	34	39	0.0	14.5	21.0	73.4	75.0	4.0	124
44	C. H. Elder	4	36	38	2.8	3.5	18.1	63.9	69.4	12.5	144
45		14	36	38	2.0	10.2	20.4	67.3	67.3	12.3	49
46	W. Rice, N. V. Bryan ranch	25	35	37	0.8	15.4	29.2	62.5	65.9	4.9	123
47		5	35	40	4.3	1.0	13.1	58.7	71.7	15.2	92
48		2	35	39	0.0	15.8	30.3	47.3	56.6	13.1	76
49		35	36	39	3.0	11.4	20.4	68.2	69.7	9.9	132
50		2	36	39	0.0	4.2	20.4	54.9	65.5	14.1	142
51	Carl May	29	36	39	1.9	9.3	17.4	55.9	57.1	25.5	161

Appendix summary (con.)

Field collections					Moth egg masses percent		Tussock moth cocoons				
							Successfully emerged percent	Killed, by percent			Total number
								Parasites			
Site no.	Locality	Sec.	Twp. (N)	Rge. (E)	1955	Older		Sarcophag.	Total	Other	
	(2) DEER PARK										
9*	Rasmussen farm	6	29	43	0.0	27.1	50.7	7.6	26.7	16.0	210
36	Wm. Erickson	11	29	42	9.5	0.0	19.0	76.2	81.0	0.0	21
38	Payne	6	29	43	1.7	.2	4.5	84.9	88.8	6.7	404
39	= #9--Rasmussen	6	29	43	20.6	10.0	62.4	17.6	29.0	8.6	165
	(3) SPANGLE-LATAH										
D-1*	Spangle, L. G. Mason farm				13.0	14.3	72.7	2.5	5.0	22.3	161
D-2	Spring Valley				35.0	0.0	65.0	4.0	16.0	19.0	75
D-3	Spring Valley Albert Schmitz farm				0.0	0.0	0.0	33.0	67.0	33.0	3
D-4*	Latah - Wm. Bippes farm				31.1	1.6	47.4	6.6	37.8	14.8	61
D-5	Latah - Oscar Schuman farm				8.6	10.6	36.0	37.0	57.0	11.5	197
D-6	Waverly - Eric Leitz farm				6.0	17.5	42.0	18.5	45.6	7.0	200
D-7*	Spangle - Detlef Jons farm				0.0	24.0	54.0	0.0	28.0	18.0	50
37*	Cheney - S.Huss farm	1	23	41	8.2	8.2	56.2	16.4	37.0	6.8	73

* Farm properties sprayed for moth control in 1955

Douglas Fir Tussock Moth Infestation 1955

COLVILLE, WASH., AND VICINITY

Legend

Shaded areas represent light defoliation by the Douglas-fir tussock moth; aerial survey of September, 1955.

x Blue-numbered spots are cocoon collection sites.

PREPARED BY
Intermountain Forest and Range Experiment Station,
U.S. Forest Service,
Missoula Forest Insect Laboratory

T37N

T36N

T35N

T34N

T33N

R38E

R39E

R40E

COLVILLE

ROOSEVELT LAKE

FRANKLIN D

RANGE

Kettle Falls

Boyds

Barstow

Bossburg

Jacknife Mtn 5057

Lookout Mtn 3597

Grande Mtn

Onion Mtn

Mt Rogers

Old Douglas 5320

Jumpoff Mtn

Old Dominion Mtn 5774

Lake City Lakes

Gillette Mountain

Douglas Falls

Meyers Falls

Hawksnest

Bangs Mtn

South Huckleberry Mtn 5273

Stahley Mtn 3359

Bald Hill

The Splitoff 2112

Rice 2990

Nicholls Mtn

Day Mtn

Granite Mtn

Freeman Hill

Arizina

Rice

Impach

Monumental Butte 2098

Inchelium

Gifford

Stranger Mtn

Keedy Hill

The Horseshoe

McMillan Hill

Brazel Hill

Deadman Hill

Old Baldy

Maud

Waterloo

Daisy

Addy (BM 1629)

Addy Mtn 4872

Deer Mtn 4081

Blue Creek

Orin

Arden

Old Fort Colville

Old Dominion Mine

Tulare Dolomite Quarry

Lucky Stone

Old Marble Quarry

Echo Mine

Big Chief

Chloride Queen

Leadville

Bonanza

Silver Trail

Vanstone (A.S.&R.Co.)

Galena Farm

Williams Lake

Perkins L

Dilly L

Ryan L

Renner Lake

Hodgson

Davis Lake

Phalon Lake

Harrier

Scott

Kohler

Marble Cr

Straus

Bruce

Garrison

Hull

Hanson

Twelvemile Mtns

Leslie

Iron

Bagley

Fork

Cliff Ridge

Addy Mtn

Security Copper Mine

Chewelah

Thomason

Northern Magnesite Plant

Liberty Copper Mine

Refuge Headquarters

Wildlife

Pend Oreille

Starvation Lake

Narcisse

White Mud L

Nettleton

Heidegger

Sauger

Carter

Valley

Harvey 2087

Quillisascut

Pleasant

Barnaby 1915

Rose 1902

Slate 1803

Rim 1769

Butcher

Jennings

Daisy 1766

Knob 1765

Hay

Camille Lake

Nicholas L

Lake Ellen

Goat 1731

Coltonwood

Lilly L

Hoodoo

Sherman

Growden

Hart

Lane

Bailey

High Bridge

Deadman

Fork

Can Merkel

Ridge

Boulder

Tom

Echo

Slide

Thompson

Matson

Doyle

Tie Camp

Kelly

Mountain

Echo

Valley

Clugston

Joe

Jumpoff

Mill

Garrison

Flat

Hull

Hanson

Old Fort Colville

Palmer Siding

Old Kettle

Power House

Meyers Falls

Cougar Can

Donaldson Draw

Canyon

Mink

Lafleur

Ark

Nuwska Cr

Sullivan

Cottonwood

Hell Creek

Flat

Gibbs

Camille Lake

Impach

Monumental Butte

Stranger Mtn

Butler

Simpson Lakes

Coulee Dam National Recreational Area

Stevens Ferry

Ferry Co

Stevens Co

Little Jim Cr

Hay

Knob

Saints Flat

McGee

Gold Hill

Courtright Can

Bradeen Creek

Hungry Hollow

Summit Ridge

Deadman Hill

Eslick Can

Twilight Can

Stranger Cr

Dunn Mtn

Dunn Creek

Blue Creek

Mill Creek

Iron Creek

Monahan Cr

Twelvemile Cr

Bagley Fork

Addy

Deer Mtn

Wellington Pk

Mingo

Aquila Mine

Daisy

Monumental Mtn

Basin

Cole

North

Spratt

Haller

Moran

Slide

Cliff Ridge

Addy Mtn

Twelvemile Mtns

Monahan

Iron Creek

Bagley Fork

Deer Mtn

Blue Creek

Liberty Copper Mine

Security Copper Mine

Chewelah

Thomason

Northern Magnesite Plant

Wellington Pk

Stranger

Hungry Hollow

Summit

Dunn

Mill

Blue

Starvation Flat

Mill River Butte

Refuge Headquarters

Wildlife

Bear

Pend Oreille

Starvation Lake

Narcisse

White Mud L

Orin

Arden

Moran

Haller

Spratt

Freeman Hill

Granite Mtn

Day Mtn

Nicholls Mtn

Harvey 2087

Quillisascut

Pleasant

Barnaby 1915

Rose 1902

Slate 1803

Rim 1769

Butcher

Jennings

Daisy 1766

Knob 1765

Hay

Camille Lake

Nicholas L

Lake Ellen

Goat 1731

Coltonwood

Lilly L

Hoodoo

Sherman

Growden

Hart

Lane

Bailey

High Bridge

Deadman

Fork

Can Merkel

Ridge

Boulder

Tom

Echo

Slide

Thompson

Matson

Doyle

Tie Camp

Kelly

Mountain

Echo

Valley

Clugston

Joe

Jumpoff

Mill

Garrison

Flat

Hull

Hanson

Old Fort Colville

Palmer Siding

Old Kettle

Power House

Meyers Falls

Cougar Can

Donaldson Draw

Canyon

Mink

Lafleur

Ark

Nuwska Cr

Sullivan

Cottonwood

Hell Creek

Flat

Gibbs

Camille Lake

Impach

Monumental Butte

Stranger Mtn

Butler

Simpson Lakes

Coulee Dam National Recreational Area

Stevens Ferry

Ferry Co

Stevens Co

Little Jim Cr

Hay

Knob

Saints Flat

McGee

Gold Hill

Courtright Can

Bradeen Creek

Hungry Hollow

Summit Ridge

Deadman Hill

Eslick Can

Twilight Can

Stranger Cr

Dunn Mtn

Dunn Creek

Blue Creek

Mill Creek

Iron Creek

Monahan Cr

Twelvemile Cr

Bagley Fork

Addy

Deer Mtn

Wellington Pk